

REMARKS:

Claims **12-22, 25, 26, and 28-38** were examined. Claims **12** and **37** are amended. No new subject matter has been introduced.

The Applicant submits that these amendments merely make explicit that which was implicit in the claims as originally filed. As such, no new matter has been entered with these amendments. Furthermore, the Applicant submits that these amendments do not narrow the scope of any claim limitation within the meaning of the decision in *Festo*. No new subject matter has been introduced.

CLAIM REJECTIONS

35 USC 103

CLAIM 12 IS ALLOWABLE OVER BRINKER IN VIEW OF DAMS, BURROWS, FUJIMORI

Claims **12-17, 19-26, and 28-38** were rejected under 35 USC 103(a) as being obvious over Brinker et al. (U.S. Patent 6,264,741) to in view of Dams (European Patent No. 1225188) and Burrows (U.S. Patent 6,866,901) and Fujimori (U.S. Patent 6,727,513). Applicant respectfully disagrees.

Fujimori Does Not Rectify the Deficiencies of the other Citations

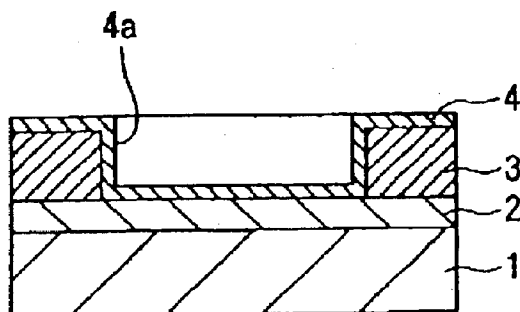
The Office acknowledges in the current Office Action of Jan. 25, 2010 on page 4, lines 8-11 that Brinker, Dams, and Burrows does not establish that it is physically possible to form a self-assembled film using a superhydrophobic monomer. To rectify this deficiency, the Office has cited the Fujimori reference as teaching a self-assembled film (col. 3, line 26). However, closer reading shows that Fujimori (col 3, line 26) states that the self-assembled film is a self-assembled single layer, not a multilayer nanolaminate of 100s to 1000s of layers. Specifically, Fujimori states:

The term "self-assembled film" as used in the present invention means a monomolecular film which is obtained by allowing a compound having a straight-chain molecule and a functional group that can be combined with the constitutive atom of a face on which the film is formed and is bonded to the straight-chain molecule to become in the state of a gas or liquid and coexistent with the face on which the film is formed. In the

monomolecular film, the functional group is adsorbed by the film-forming face and is bonded with the constitutive atom of the film-forming face, and the straight-chain molecule is formed facing the outside. This monomolecular film is referred to as a self-assembled film, since it is formed by spontaneous chemical adsorption of the compound to the film-forming face. (Fujimori: col 3, lines 26-39)

Thus, all of the teachings in Fujimori provide no additional teaching or suggestion as to the self-assembly of a multi-layer nanolaminate having more than one layer with a superhydrophobic material. As seen in the above text, Fujimori teaches only the formation of a single self-assembled monomolecular film, not a multi-layer nanolaminate. Figure 4(a) in Fujimori (shown below) emphasizes that the self-assembled film 4 of Fujimori is but a single layer, not a self-assembled multi-layer nanolaminate.

(a)



[FIG. 4]

Fujimori does **not** establish that it is known in the art that it is physically possible to form a multi-layer nanolaminate wherein more than one layer has the superhydrophobic material. Furthermore the single layer described in Fujimori cannot serve as the substrate for which a tortuous path exist, because by definition, a tortuous path requires interconnection of randomly sited pinholes from multiple adjacent layers.

Furthermore, Brinker has already discarded the Langmuir-Blodgett monolayer self-assembly of Fujimori (see Fujimori: col 3, lines 36-43) as being incompatible to forming the proposed nanocomposite described in Brinker.

In an attempt to mimic these examples from nature, a synthetic process termed "biomimetics" has gained momentum within the scientific community. Such approaches include crystallization beneath Langmuir monolayers, crystallization on self-assembled monolayers, supramolecular self-assembly (SSA), and sequential deposition (SD). Of these only SSA and SD offer the ability to introduce the periodic microstructural and compositional changes necessary for layered nanocomposite formation. (Brinker, Col. 1, lines 36-44).

Accordingly, there is no teaching with regards to a self-assembled multi-layer nanolaminate in Fujimori that rectifies the deficiencies of Brinker, Dams, and Burrows. No where does Fujimori speak to this or rectify the deficiencies of Brinker, Dams, and Burrows with regards to self-assembly of a multi-layer nanolaminate with superhydrophobic material in more than of the organic polymer layers. Self-assembly of a single layer is insufficient; self-assembled multilayer is required in the claimed invention. Furthermore, even if a single layer can be self-assembled, that alone provides no teaching on how to establish the self-assembly of many multiple layers having the superhydrophobic material.

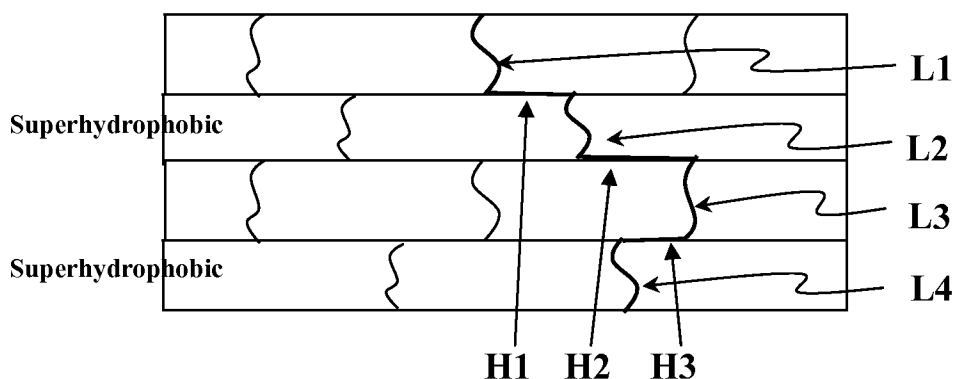
The previously submitted Chandler affidavit of June 11, 2009 shows that it would not have been obvious that a multilayer nanolaminate as claimed could be formed and nothing in Fujimori provides a further teaching in that regards.

Providing a Single Self-Assembled Layer is Insufficient

A self-assembled single layer will not work to provide the desired impermeability - no tortuous paths are created by having a single self-assembled layer as taught by Fujimori. To illustrate this point, Applicant presents the following simplification. For purposes of this example only, a single layer of superhydrophobic material can provide a certain density of superhydrophobic moieties μ . Thus, in a simplified form, the resistance to water permeability may be characterized by $\mu \times N1 \times L1$, where μ is the described density of superhydrophobic material, $L1$ is the tortuous path length for the layer and $N1$ is the number of layers (which in this example is 1).



However, a multi-layer configuration creates a much high resistance to moisture permeability due to increased number of layers, which in turn creates the increased tortuous path length which further increase the ability of the superhydrophobic material to provide surfaces that resist moisture permeation: $\mu \times (N1+N2+....) \times (L1+L2+....) \times (H1+H2+...)$, wherein H1, H2, H3...represents the horizontal path length between layers.



Thus, although Fujimori teaches a single self-assembled layer, the presently claimed embodiment using a self-assembled multi-layer nanolaminate is superior. Even an **extremely thick** single layer of Fujimori material would not suffice because without multiple layers, there is no tortuous path and any pinholes or defects would extend through the entire layer without having to traverse a path with a plurality of repeated turns or bends.

Claims 12 and 37 are amended to further emphasize the above. Claim 12 recites that the random location of pinholes in the layers of the inorganic material and the layers of the organic polymer requires a tortuous pathway marked by repeated turns or bends for any water to pass through the self-assembled barrier film structure, wherein the superhydrophobic material in more than one of the layers of the organic polymer provide surfaces that impede that movement of water between adjacent layers of the organic polymer and the inorganic material. Support can be found in text at page 3, lines 22-30, page 7, lines 27-30, and Figure 1.

Even if combined, Structural Features in Claim 12 are not shown by the proposed combination

Applicants further emphasize structural elements in independent claim 12 not shown by the citations from the Office, even if all were combined as suggested by the Office. By way nonlimiting example, claim 12 recites that:

adjacent layers of the organic polymer and the inorganic material are covalently bonded layers characterized by direct organic polymer to inorganic material covalent bonds which form in the self-assembled structure even with superhydrophobic material in more than one of the layers of the organic polymer;

Thus, the self-assembly of many of these layers at the same time creates **covalent bonding between adjacent layers** of the self-assembled multilayer nanolaminate. There is no teaching that that bonding is created by forming single monolayers of material in a non-self-assembled manner, or that such bonds can be formed between layers if the single self-assembly layer of Fujimori is introduced together with the teachings of the other references.

The layers of organic polymer AND the layers of inorganic material are both formed as part of the self-assembly. In many of the citations, there is no teaching **both** of the layer types of formed through self-assembly.

Furthermore, the majority of the citations discussion formation of layers as individual steps, not through self-assembly of multiple layers. For example, the deposition of the barrier layers and the decoupling layers in Burrows appear as separate steps, none of which are shown to be self-assembly methods that form the claimed covalent bonds between adjacent layers. For example, Burrows recites formation of the layers using a plurality of sequential steps (depositing, etching, depositing, etc...):

Alternatively, depositing the at least one barrier stack adjacent to the substrate may include, but is not limited to, depositing the first decoupling layer having an initial area of decoupling material which is greater than the area of the first decoupling layer, etching the first decoupling layer having the initial area of decoupling material to remove a portion of the decoupling material so that the first decoupling layer has the area of the first decoupling layer, and depositing the first barrier layer. Etching the first decoupling layer may include, but is not limited to, providing a solid mask over the first decoupling layer having the initial area of decoupling material, and etching the first decoupling layer

having the initial area of decoupling material to remove the portion of the decoupling material outside the solid mask so that the first decoupling layer has the area of the first decoupling layer. (Burrows, col. 3, lines 10-27).

As such, the citations fail to show or suggest the covalent bonding between adjacent layers that forms by way of self-assembly recited in the claimed invention.

Furthermore, even if Brinker were combined with Dams, Burrows, and Fujimori, the resulting device would not be the invention as set forth herein. The teachings of Dams merely suggests a surface application of its fluorochemical silane (see page 3, lines 20-25). Dams describes applying the material to substrates or applied to hard surfaces. Combining Brinker with Dams merely results in a top layer with Dams' fluorochemical silane, not incorporation of superhydrophobic material into the nanolaminate as presently claimed. Nothing in Burrows provides an enabling disclosure as to how one can incorporate a superhydrophobic material into the self-assembled structure of Brinker. Fujimori only teaches formation of single monolayers, which is not enabling as to how to incorporate the superhydrophobic material into the Brinker multi-layers. As the cited references fail to show or suggest all elements of the claimed invention, Applicant respectfully requests that the rejection to claim 12 be withdrawn.

The Proposed Combination is Prohibited by the MPEP

Furthermore, the propriety of combining the teachings of Brinker, Dams, Burrows, and Fujimori has not been established. Specifically, MPEP 2143.01 prohibits the combination of references where the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified.

- a) Brinker discloses a self-assembly process.
- b) Dams describes various non-self-assembly coating techniques for depositing the superhydrophobic material (see below).

A wide variety of coating methods can be used to apply a composition of the present invention, such as brushing, spraying, dipping, rolling, spreading, and the like. A preferred coating method for application of a fluorochemical silane of the present invention includes spray application. (Dams, pg 22, lines 12-16).

- c) Burrows describes many deposition techniques, none described as self-assembly.

The barrier layers may be deposited by any suitable process including, but not limited to, conventional vacuum processes such as sputtering, evaporation, sublimation, chemical vapor deposition (CVD), plasma enhanced chemical vapor deposition (PECVD), electron cyclotron resonance-plasma enhanced vapor deposition (ECR-PECVD), and combinations thereof. (Burrows, col. 7, lines 1-7)

d) Fujimori: describes self-assembly as chemical adsorption to form a single monolayer.

This monomolecular film is referred to as a self-assembled film, since it is formed by spontaneous chemical adsorption of the compound to the film-forming face.

In this connection, the self-assembled film is described in detail by A. Ulman in Chapter 3 of "An Introduction to Ultrathin Organic Film From Langmuir-Blodgett to Self-assembly" (Academic Press Inc., Boston, 1991). (Fujimori: col 3, lines 36-43)

It is entirely unclear how the teachings of the above references can be combined without significantly altering the fundamentals of the Brinker self-assembly process. As previously mentioned, Brinker has already discarded the Langmuir-Blodgett monolayer self-assembly as being incompatible with the proposed invention.

Such approaches include crystallization beneath Langmuir monolayers, crystallization on self-assembled monolayers, supramolecular self-assembly (SSA), and sequential deposition (SD). Of these only SSA and SD offer the ability to introduce the periodic microstructural and compositional changes necessary for layered nanocomposite formation. (Brinker, Col. 1, lines 36-44).

Thus, based on the foregoing, the teachings of Fujimori has been established by Brinker as inappropriate for Brinker's technique, without significant fundamental changes.

Applicants are proceeding contrary to accepted wisdom

Per MPEP 2145(X)(D)(3), **proceeding contrary to accepted wisdom is evidence of nonobviousness**. Applicant submits that the material with Brinker seeks to mimic which hydrates like nacre would make for a poor moisture barrier and using that material as the basis for a moisture barrier is proceeding contrary to accepted wisdom. Specifically, Brinker seeks to mimic nacre (see Brinker Col. 1, lines 35-50), but nacre is not a water barrier. Nacre is easily hydrated after only five hours of soaking in water (see, e.g., Barthelat, "Tensile Testing of Abalone Nacre Miniature Specimens Using Microscopy and Speckle Correlation", page 2, col. 4,

paragraph 2), and the toughness of the material is related to the degree of hydration (see, e.g., Menig et al., Quasi-static and Dynamic Mechanical Response of *Haliotis Rufescens* (Abalone Shells), Acta Mater. 48 (2000), page 2392, col. 1). Absent the teachings found in Applicant's patent application, there is no motivation for one of skill in art to modify the nacre-like material of Brinker to be a moisture barrier. Applicant has proceeded against accepted wisdom by incorporating water barrier qualities into the presently claimed laminate and by starting with a poor moisture barrier material.

Based on the foregoing, Claim 12 and its dependent claims are allowable over the citations.

Claim 37 is allowable for substantially the same reasons set forth for claim 12. Claim 37 was also previously amended to recite a photovoltaic device wherein a bottom layer of the barrier film in contact with the photovoltaic device is an inorganic layer. Such a configuration is shown in Figure 1 and is beneficial as it prevents undesired interaction between the photovoltaic device and any organic material which may cause degradation in the cell.

Accordingly, Claims 12, 37, and their dependent claims are allowable over the citations and Applicants respectfully request that the current rejections be withdrawn.

CONCLUSION

For the reasons set forth above, the Applicant submits that all claims are allowable over the cited art and define an invention suitable for patent protection. If the Examiner believes a telephone conference would expedite prosecution of this application, please contact the undersigned attorney at the number listed below.

Respectfully submitted,

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Date: July 26, 2010

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